Appendix A.
Air Quality Emission Calculations

Lompoc Wind Energy
Emissions Summary

Construction Emissions

	Emissions (tons/project)		
	ROG	NOx	PM_{10}
TOTAL (ton/project)	3	19	6
SBCAPCD Threshold (ton/yr)	25	25	NA
Threshold Exceeded?	No	No	NA

[b] SBCAPCD, Scope and Content of Air Quality Sections in Environmental Documents, January 2007.

Operation Emissions

	Emissions (tons/project)		
	ROG	NOx	PM_{10}
TOTAL (lb/day)	0.3	1.2	18
Threshold - Mobile and Stationary Sources (lb/day)[a]	55	55	80
Threshold - Motor Vehicle Trips (lb/day)[a]	25	25	NA
Threshold Exceeded?	No	No	No

[a]County of Santa Barbara Significance Thresholds and Guideline Manual, Revised October 2006.

Lompoc Wind Energy
Construction Emissions

Table 1a. Construction Emission Summary (lb/day)

Construction Activity	Duration of Activity (months)	Emissions (lb/day)[1,2] ROG	NOx	CO	Exhaust PM_{10}	Fugitive PM_{10}
Site Preparation and Road Construction	2	32.35	223.24	256.2	9.19	20
Foundation Construction	4	9.71	65.15	77.68	2.51	20
Electrical Collection System	2	9.92	63.18	81.07	2.17	20
Power Line Construction	6	8.95	57.65	72.01	2.15	20
Substation, O&M Building, and Meteorological Tower	3	9.93	68.25	78.63	2.74	20
Turbine Installation	3	9.62	58.98	80.32	1.97	20

Table 1b. Construction Emission Summary (tons/activity)

Construction Activity	Duration of Activity (months)	Emissions (ton/activity)[3,4] ROG	NOx	CO	Exhaust PM_{10}	Fugitive PM_{10}
Site Preparation and Road Construction	2	0.71	4.91	5.64	0.20	0.44
Foundation Construction	4	0.43	2.87	3.42	0.11	1.60
Electrical Collection System	2	0.22	1.39	1.79	0.05	0.44
Power Line Construction	6	0.60	3.88	4.88	0.14	1.32
Substation, O&M Building, and Meteorological Tower	3	0.33	2.25	2.60	0.09	0.66
Turbine Installation	3	0.32	1.95	2.65	0.07	0.66
TOTAL (ton/project)		**2.60**	**17.25**	**20.98**	**0.66**	**5.12**
SBCAPCD Threshold (ton/yr)		**25**	**25**	**NA**	**NA**	**NA**
Threshold Exceeded?		No	No	NA	NA	NA

1.Output from URBEMIS2002 (version 8.7.0). The emissions were based on the construction schedule, equipment types, horsepower, load, and hours of operation in Table 2.

2. Calculations assume 2 acres per day disturbed during each construction activity.

3. The URBEMIS2002 default of 22 days per month was used to calculate emissions in units of tons per activity.

4. The tons/activity emissions include the truck emissions by construction activity summarized in Table 6b, concrete batch plant emissions summarized in Table 7 are included with Foundation Construction, and helicopter emissions summarized in Table 9 are included with Power Line Construction.

Lompoc Wind Energy
Construction Emissions

Table 2. Construction Schedule and Equipment Summary

Equipment	Fuel Type	Number of Equipment	Horsepower	Load	Operation (hours per day)	Equipment Type in URBEMIS*
Construction Activity: Site Preparation and Road Construction						
Duration: 2 months, Year 2007						
Excavator	Diesel	2	180	0.58	8	Excavator
D-9 bulldozer	Diesel	1	474	0.59	8	Other equipment
D-8 bulldozer	Diesel	2	305	0.59	8	Rubber-tired dozer
D-6 bulldozer	Diesel	1	185	0.59	8	Off highway tractor
980 front-end loader	Diesel	1	165	0.465	8	Rubber-tired loader
14-H load grader	Diesel	1	215	0.575	8	Grader
Compactor	Diesel	2	84	0.73	8	Concrete/industrial saw
Scraper	Diesel	2	313	0.66	8	Scraper
Forklift	Diesel	1	94	0.475	8	Rough terrain forklift
Generator	Diesel	1	119	0.82	8	Signal boards
Construction Activity: Foundation Construction						
Duration: 4 months, Year 2008						
D-6 bulldozer	Diesel	1	185	0.59	8	Off highway tractor
980 front-end loader	Diesel	1	165	0.465	8	Rubber-tired loader
14-H load grader	Diesel	1	215	0.575	8	Grader
Compactor	Diesel	2	84	0.73	8	Concrete/industrial saw
Forklift	Diesel	1	94	0.475	8	Rough terrain forklift
Generator	Diesel	1	119	0.82	8	Signal boards
Construction Activity: Electrical Collection System						
Duration: 2 months, Year 2008						
Excavator	Diesel	2	180	0.58	8	Excavator
980 front-end loader	Diesel	1	165	0.465	8	Rubber-tired loader
Compactor	Diesel	2	84	0.73	8	Concrete/industrial saw
Trencher	Diesel	1	82	0.695	8	Trencher
Generator	Diesel	1	119	0.82	8	Signal boards
Construction Activity: Power Line Construction						
Duration: 6 months, Year 2008						
980 front-end loader	Diesel	1	165	0.465	8	Rubber-tired loader
120-ton crane	Diesel	1	190	0.43	8	Crane
14-H load grader	Diesel	1	215	0.575	8	Grader
Compactor	Diesel	2	84	0.73	8	Concrete/industrial saw
Generator	Diesel	1	119	0.82	8	Signal boards
Construction Activity: Substation, O&M Building, and Meteorological Tower						
Duration: 3 months, Year 2008						
D-9 bulldozer	Diesel	1	474	0.59	8	Other equipment
D-8 bulldozer	Diesel	1	305	0.59	8	Rubber-tired dozer
14-H load grader	Diesel	1	215	0.575	8	Grader
Forklift	Diesel	1	94	0.475	8	Rough terrain forklift
Generator	Diesel	1	119	0.82	8	Signal boards
Construction Activity: Turbine Installation						
Duration: 3 months						
980 front-end loader	Diesel	1	165	0.465	8	Rubber-tired loader
300-ton crane	Diesel	1	190	0.43	8	Crane
120-ton crane	Diesel	1	190	0.43	8	Crane
90-ton crane	Diesel	2	190	0.43	8	Crane
Forklift	Diesel	1	94	0.475	8	Rough terrain forklift
Generator	Diesel	1	119	0.82	8	Signal boards

*In order to account for the different horsepower of the bulldozers, the D-6 and D-9 bulldozers were loaded into URBEMIS as a different equipment types for activities with more than one bulldozer. For some equipment, such as the compactor, URBEMIS does not have this specific equipment type so a similar type of equipment was used to represent compactor emissions.

Lompoc Wind Energy
Truck Emissions

Table 3. On-Site Truck Miles Traveled

Trucks	Number of Trucks[1]	Average Roundtrip Distance Traveled by Each Truck (Miles)[2]	Total Vehicle Miles Traveled for the Project (VMT)
Trucks for Transport			
WTG Parts	1,280	12	15,360
WTG Foundation	3,450	12	41,400
WTG Water	3,000	12	36,000
Access Roads	2,646	12	31,752
Pole Placement	1,014	12	12,168
Line Stringing	160	12	1,920
Meteorological Tower	120	12	1,440
Substation and O&M Building	60	12	720
Trucks Associated with Construction Activities			
Site Preparation and Road Construction			
Diesel Trucks (water, dump, line)	7	12	84
Pick-up truck (gasoline)	14	12	168
Foundation Construction			
Diesel Trucks (water, dump, line)	14	12	168
Pick-up truck (gasoline)	14	12	168
Electrical Collection System			
Diesel Trucks (water, dump, line)	6	12	72
Pick-up truck (gasoline)	8	12	96
Power Line Construction			
Diesel Trucks (water, dump, line)	9	12	108
Pick-up truck (gasoline)	14	12	168
Substation, O&M Building, and Met Tower			
Diesel Trucks (water, dump, line)	6	12	72
Pick-up truck (gasoline)	8	12	96
Turbine Installation			
Diesel Trucks (water, dump, line)	3	12	36
Pick-up truck (gasoline)	14	12	168

1. Number of truck trips from Table 2-3 Section 2.0 Project Description.
2.The distance traveled estimated based on size of Project site, Figure 2-2.

Table 4. Emission Factors (EF)

	ROG	NOx	CO	PM_{10}
Heavy-duty diesel Emission Factor (g/mile)	2.158	11.396	19.091	0.653
Heavy-duty diesel Emission Factor (lb/mile)	0.0048	0.0251	0.0421	0.0014
Gasoline pick-up Emission Factor (g/mile)	0.537	0.856	8.931	0.065
Gasoline pick-up Emission Factor (lb/mile)	0.0012	0.0019	0.0197	0.0001

Emission factors from EMFAC2007 v 2.3 for Santa Barbara County for a heavy duty diesel truck traveling 15 miles per hour.

Lompoc Wind Energy
Truck Emissions

3. On-Site Emissions

Equation: **E = (VMT*EF)**
Where,
E = Emissions (lb/project)
VMT = Vehicle miles traveled/project
EF = EMFAC emission factor (lb/mile)

Table 5a. Transport Truck Emissions (lb/project)

Trucks for Transport	Emissions (lb/activity)			
	ROG	NOx	CO	PM_{10}
WTG Parts	73.08	386	646	22.11
WTG Foundation	196.96	1,040	1,742	59.60
WTG Water	171.27	904	1,515	51.83
Access Roads	151.06	798	1,336	45.71
Pole Placement	57.89	306	512	17.52
Line Stringing	9.13	48	81	2.76
Meteorological Tower	6.85	36	61	2.07
Substation and O&M Building	3.43	18	30	1.04

Table 5b. Transport Truck Emissions (tons/project)

Trucks for Transport	Emissions (tons/project)			
	ROG	NOx	CO	PM_{10}
WTG Parts	0.0365	0.193	0.323	0.011
WTG Foundation	0.0985	0.520	0.871	0.030
WTG Water	0.0856	0.452	0.758	0.026
Access Roads	0.0755	0.399	0.668	0.023
Pole Placement	0.0289	0.153	0.256	0.009
Line Stringing	0.0046	0.024	0.040	0.001
Meteorological Tower	0.0034	0.018	0.030	0.001
Substation and O&M Building	0.0017	0.009	0.015	0.0005
TOTAL (tons/project)	0.33	1.77	2.96	0.10

Lompoc Wind Energy
Truck Emissions

Table 6a. Emissions from Trucks Associatd with Construction Activities (lb/project)

Trucks Associated with Construction Activities	Emissions (lb/project)			
	ROG	NOx	CO	PM_{10}
Site Preparation and Road Construction				
Diesel Trucks (dump, line)	0.40	2.11	3.54	0.12
Pick-up truck (gasoline)	0.20	0.32	3.31	0.02
Foundation Construction				
Diesel Trucks (dump, line)	0.80	4.22	7.07	0.24
Pick-up truck (gasoline)	0.20	0.32	3.31	0.02
Electrical Collection System				
Diesel Trucks (dump, line)	0.34	1.81	3.03	0.10
Pick-up truck (gasoline)	0.11	0.18	1.89	0.01
Power Line Construction				
Diesel Trucks (water, dump, line)	0.51	2.71	4.55	0.16
Pick-up truck (gasoline)	0.20	0.32	3.31	0.02
Substation, O&M, and Meteorological Tower				
Diesel Trucks (dump, line)	0.34	1.81	3.03	0.10
Pick-up truck (gasoline)	0.11	0.18	1.89	0.01
Turbine Installation				
Diesel Trucks (dump, line)	0.17	0.90	1.52	0.05
Pick-up truck (gasoline)	0.20	0.32	3.31	0.02

Table 6b. Emissions from Trucks Associatd with Construction Activities (ton/project)

Trucks Associated with Construction Activities	Emissions (tons/project)			
	ROG	NOx	CO	PM_{10}
Site Preparation and Road Construction				
Diesel Trucks (dump, line)	2.00E-04	1.06E-03	1.77E-03	6.05E-05
Pick-up truck (gasoline)	9.94E-05	1.59E-04	1.65E-03	1.20E-05
Foundation Construction				
Diesel Trucks (dump, line)	4.00E-04	2.11E-03	3.54E-03	1.21E-04
Pick-up truck (gasoline)	9.94E-05	1.59E-04	1.65E-03	1.20E-05
Electrical Collection System				
Diesel Trucks (dump, line)	1.71E-04	9.04E-04	1.52E-03	5.18E-05
Pick-up truck (gasoline)	5.68E-05	9.06E-05	9.45E-04	6.88E-06
Power Line Construction				
Diesel Trucks (dump, line)	2.57E-04	1.36E-03	2.27E-03	7.77E-05
Pick-up truck (gasoline)	9.94E-05	1.59E-04	1.65E-03	1.20E-05
Substation, O&M, and Meteorological Tower				
Diesel Trucks (dump, line)	1.71E-04	9.04E-04	1.52E-03	5.18E-05
Pick-up truck (gasoline)	5.68E-05	9.06E-05	9.45E-04	6.88E-06
Turbine Installation				
Diesel Trucks (dump, line)	8.56E-05	4.52E-04	7.58E-04	2.59E-05
Pick-up truck (gasoline)	9.94E-05	1.59E-04	1.65E-03	1.20E-05
TOTAL (tons/project)	1.80E-03	7.60E-03	1.99E-02	4.51E-04

Lompoc Wind Energy

Portable Concrete Batch Plant Emissions

Project Information

200 cubic yard of concrete per foundation (from Section 2.0 Project Description)
80 maximum number of turbines (from Section 2.0 Project Description)
2 maximum number of batch plants operating on same day

Table 7. Portable Concrete Batch Plant Emission Summary

Daily Emissions		Annual Emissions	
Uncontrolled PM_{10} Emissions (lb/day)	Controlled PM_{10} Emissions (lb/day)	Uncontrolled PM_{10} Emissions (ton/yr)	Controlled PM_{10} Emissions (ton/yr)
36.04	6.48	0.72	0.13

Daily emission calculation assumes maximum of two batch plants would operate on the same day.
Annual emission calculation assumes 80 foundations placed.

Table 8. Concrete Batch Plant Emission Factors

Emission Source	Uncontrolled PM_{10} Emission Factor (lb/yd^3)	Controlled PM_{10} Emission Factor (lb/yd^3)
Aggregate delivery to ground storage	0.0031	0.0031
Sand delivery to ground storage	0.0007	0.0007
Aggregate transfer to conveyor	0.0031	0.0031
Sand transfer to conveyor	0.0007	0.0007
Aggregate transfer to elevated storage	0.0031	0.0031
Sand transfer to elevated storage	0.0007	0.0007
Cement delivery to silo	0.0001	0.0001
Cement supplement delivery to silo	0.0002	0.0002
Truck mix loading[1]	0.0784	0.0045
Total Emission Factor (lb PM_{10}/yd^3)	0.090	0.016

Emission factors from AP-42, Fifth Edition, Chapter 11.12 Table 11-12-5 Plant Wide Emission Factors (lb/yd3), June 2006, http://www.epa.gov/ttn/chief/ap42/
[1]Emission factor from Equation 11.12-2 and Table 11.12-2.

Lompoc Wind Energy

Helicopter Emission Calculations

Table 9. Helicopter Emissions Summary

Daily Emissions (lb/day)				
CO	**HC**	**NOx**	**SOx**	**PM**
8.03	0.50	4.58	0.42	0
Annual Emissions (ton/yr)				
CO	**HC**	**NOx**	**SOx**	**PM**
0.120	0.007	0.069	0.006	0

Daily emissions calculated assuming 1 LTO per day and 3 hours for pole installation per LTO.
Annual emissions calculated assuming 5 trips (LTO) per month over six-month construction period.

Table 10. Helicopter Emission Factors

				Emission Factors (lbs/min)					
Helicopter	**Engine Type**	**Mode**		**CO**	**HC**	**NOx**	**SOx**	**PM**	**Minutes/LTO**
BELL 206	250B17B	1	Approach	0.0686777	0.007566187	0.0032011	0.0007857	0	6.50
	250B17B	2	Climb	0.0368677	0.001634931	0.0243605	0.0022072	0	4.33
	250B17B	3	Take-off	0.0345047	0.001325406	0.0291589	0.0023857	0	2.17
	250B17B	4	Idle	0.1013631	0.020899608	0.001045	0.0005643	0	7.00

It was assumed that the Bell 206 engine represents the emissions profile of a helicopter that would be used for pole installation.
Emission factors for the Bell 206 engine are from the Federal Aviation Administration, Emissions and Dispersion Modeling System (EDMS).
Time per mode based on default times in EDMS.

Lompoc Wind Energy

Helicopter Emission Calculations

Table 11. Landing/Take-Off Emissions

	Emissions (lbs/LTO)				
Engine Mode	**CO**	**HC**	**NOx**	**SOx**	**PM**
Approach	0.446	0.049	0.021	0.005	0
Climb	0.160	0.007	0.105	0.010	0
Take-off	0.075	0.003	0.063	0.005	0
Idle	0.710	0.146	0.007	0.004	0
	TOTAL:				
	1.390	**0.205**	**0.197**	**0.024**	**0**

Table 12. Helicopter Operation Emissions during Pole Installation

Minutes operation per day 180

	Emissions (lbs/LTO)				
Engine Mode	**CO**	**HC**	**NOx**	**SOx**	**PM**
Climb	6.64	0.29	4.38	0.40	0

Assume helicopter operates for 3 hours per day per LTO when used for pole installation.

Lompoc Wind Energy

Operation Emissions

Table 13. Operation Emissions

Operation	Emissions (lb/day)[1]				Emissions (ton/yr)[2]			
	ROG	NOx	CO	PM_{10}	ROG	NOx	CO	PM_{10}
Forklift	0.20	1.14	1.67	0.03	0.037	0.21	0.30	0.0055
On-site Trucks	0.09	0.05	0.84	17.85	0.016	0.009	0.153	3.26
TOTAL (lb/day)	0.29	1.19	2.51	17.88				
Threshold - Mobile and Stationary Sources (lb/day)	55	55	NA	80				
Threshold - Motor Vehicle Trips (lb/day)	25	25	NA	NA				

1. Output from URBEMIS2002 (version 8.7.0) assuming an operation year of 2008, a vehicle mix of 100% light duty trucks traveling 20 miles per day onsite on unpaved roads at 15 mph, and one forklift operating 2 hours per day.
2. Calculation assumes 365 days per year.

3. The most conservative thresholds were used to evaluate impacts. The threshold for ROG and NOx is based on the County of Santa Barbara Environmental Thresholds and Guidelines Manual, Revised October 2006.